

## **REMARKS**

### **I. Introduction**

By the present Amendment, claim 1 has been amended. No claims have been added or cancelled. Accordingly, claims 1-10 remain pending in the application. Claims 1, 3, 5, 7, and 10 are independent.

### **II. Office Action Summary**

In the Office Action of October 8, 2009, claims 1 and 2 were rejected under 35 USC §112, second paragraph, as being incomplete. Claims 1-9 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 5,315,562 issued to Bradley et al. ("Bradley") in view of U.S. Patent No. 5,228,009 issued to Forestieri et al. ("Forestieri"). Claim 10 was rejected under 35 USC §103(a) as being unpatentable over Bradley in view of Forestieri, and further in view of U.S. Patent No. 5,570,691 issued to Wright et al. ("Wright"). These rejections are respectfully traversed.

### **III. Rejections under 35 USC §112**

Claims 1 and 2 were rejected under 35 USC §112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements. This omission was considered to be a gap between the necessary structural connections of elements. In particular, the Office Action indicates that claims 1 and 2 relate to a Doppler velocity detection device but do not recite any structural limitations. The Office Action further indicates that the claims appear to be directed to a method, and claim 1 does not have a preamble.

By the present Amendment, Applicants have amended independent claim 1 to separate the preamble of the claim from the remaining portions, and introduce structural components to properly classify claim 1 as an apparatus. For example, a transmit/receive unit has been introduced, as well as a signal detector/analyzer unit for performing some of the functions previously recited in the claim. See paragraphs [0042] and [0077] of the published application. Claim 2 depends from independent claim 1, and further restricts the scope of that claim.

It is therefore respectfully submitted that, as amended, presently pending claims satisfy the requirements of 35 USC §112, second paragraph. Withdrawal of this rejection is therefore respectfully requested.

#### **IV. Rejections under 35 USC §103**

Claims 1-9 were rejected under 35 USC §103(a) over Bradley in view of Forestieri. Regarding this rejection, the Office Action indicates that Bradley discloses a system and method for measuring velocities using a single coded pulse generator. The Office Action further indicates that Bradley uses a maximum likelihood estimation technique to process echo signals received from a plurality of transducers. In particular, it is noted that the beam pattern can be represented as a finite series of Legendre polynomials which allows the spatial correlation function to be a function of the sum of integrals which involve the  $n^{\text{th}}$  term of the beam pattern. The Office Action admits that Bradley fails to explicitly mention obtaining a velocity signal of the moving reflector on the basis of ratio between magnitudes of each complex expansion coefficient. However, Bradley is indicated as disclosing estimation of the velocity using the phase shift of the highest correlation coefficient. Forestieri is relied upon for disclosing multiple Legendre polynomials wherein an

expansion coefficient of an even-numbered degree term and an expansion coefficient of an odd-numbered degree term is different by one degree. Forestieri is further relied upon for disclosing an imaginary unit as a coefficient and complex coefficients, and fitting linear drift of each waveform with sinusoids that have integer numbers of full cycles. The Office Action concludes that it would have been obvious to modify Bradley using the teachings of Forestieri in order to arrive at the claimed invention. Applicants respectfully disagree.

As amended, independent claim 1 defines a Doppler velocity detection device that comprises:

- a transmit/receive unit for transmitting/receiving pulse waves to/from an object whose velocity is to be measured a plurality of times, and

- a signal detector/analyzer unit for analyzing the velocity of the object whose velocity is to be measured, based on the received signals,

- wherein said signal detector/analyzer unit obtains reception echo time-series signals by arranging reception echo signals of equal lapse time from transmission times of pulses in order of the transmission times and expands the reception echo-time series signals as components of a Legendre polynomial, and obtains a velocity signal of the object whose velocity is to be measured on the basis of the magnitudes of expansion coefficients.

The Doppler velocity detection device of independent claim 1 includes a transmit/receive unit for transmitting and receiving pulse waves to/from an object whose velocity is to be measured a plurality of times, and a signal detector/analyzer unit for analyzing the velocity of the object whose velocity is to be measured based on the received signals. According to independent claim 1, the signal detector/analyzer unit obtains reception echo time-series signals by arranging reception echo signals of equal lapse time from transmission times of pulses in

order of the transmission times, and expands the reception echo time-series as components of a Legendre polynomial. Additionally, the signal detector/analyzer obtains a velocity signal of the object based on the magnitudes of the expansion coefficients.

The Office Action alleges that the combination of Bradley and Forestieri discloses all of the features recited in the claimed invention. This does not appear to be the case. Bradley discloses a correlation device that includes maximum likelihood estimation techniques for processing echo signals received from a plurality of transducers. Contrary to the assertions made in the Office Action, Bradley does not utilize the Legendre polynomials to estimate the velocity. Clearly, it is the beam pattern that is represented as the finite series of Legendre polynomials. According to Bradley, the beam pattern  $W(\theta)$  can be represented as a finite series of Legendre polynomials with coefficients  $b_n$  so that the spatial correlation function can be further represented as the sum of integrals which involve the  $n$ th term of the beam pattern. See column 13, lines 13-24. Forestieri indicates that data corresponding to inbound pressure waves are divided into bins and each bin is used to calculate a velocity estimate. See column 11, lines 13-20. Clearly, Bradley is incapable of obtaining the velocity signal of the subject based on the magnitudes of expansion coefficients of the Legendre polynomial.

Forestieri, on the other hand, discloses a signal processing apparatus that is used to eliminate clutter signals from desirable signals. Orthonormal basis functions are subtracted from signal samples in order to remove the clutter. This function is performed in order to eliminate the need for filters. Forestieri only uses the Legendre series to remove the clutter so that a frequency estimation can be performed using an arctangent operation to subsequently determine the velocity.

The Legendre series is never used to determine velocity, but rather is used for elimination of clutter. The cited references simply fail to provide any disclosure or suggestion for features recited in independent claim 1, such as:

a signal detector/analyzer unit for analyzing the velocity of the object whose velocity is to be measured, based on the received signals,

wherein said signal detector/analyzer unit obtains reception echo time-series signals by arranging reception echo signals of equal lapse time from transmission times of pulses in order of the transmission times and expands the reception echo-time series signals as components of a Legendre polynomial, and obtains a velocity signal of the object whose velocity is to be measured on the basis of the magnitudes of expansion coefficients.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claim 2 depends from independent claim 1, and is therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

Independent claim 3 defines a Doppler velocity detection device that includes, in part:

wherein the velocity analyzing means obtains a complex expansion coefficient by linearly connecting an expansion coefficient of an even-numbered degree term and an expansion coefficient of an odd-numbered degree term which is different from the even-numbered degree term by one degree, derived when reception echo time-series signals obtained by arranging reception echo signals of equal lapse time from pulse transmission times in order of the transmission times are expanded as components of a Legendre polynomial starting from the 0th degree, by using an imaginary unit as a coefficient, and obtains a signed velocity signal of a moving reflector in the subject on the basis of the ratio between the magnitude of each complex expansion coefficient and the magnitude of an interval between the complex expansion coefficients.

According to at least one feature of independent claim 3, the Legendre polynomial is used to obtain a velocity signal. As previously discussed with respect to independent claim 1, such features are not shown or suggested by the art of record.

It is therefore respectfully submitted that independent claim 3 is allowable over the art of record.

Claim 4 depends from independent claim 3, and is therefore believed allowable for at least the reasons set forth above with respect to independent claim 3. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

Independent claims 5, 7, and 10 each recite ultrasonographic devices which utilizes Legendre polynomials to determine velocity. As previously discussed, the cited references fail to provide any disclosure or suggestion for such features. Rather, Forestieri utilizes polynomial expansion only to remove clutter. An arctangent calculation is used to determine the velocity.

It is therefore respectfully submitted that independent claims 5, 7, and 10 are allowable over the art of record.

Claim 6 depends from independent claim 5, and claims 8 and 9 depend from independent claim 7. Accordingly, these claims are believed to be allowable for at least the reasons set forth above with respect to independent claims 5 and 7.

**V. Conclusion**

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

**AUTHORIZATION**

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 520.46163X00).

Respectfully submitted,  
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